



CONTROLLED
RECORD OF TECHNICAL CHANGE

Technical Change No. 2

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Project/Job No. 799419.0056.0005

Date 11/22/99

Project/Job Name Project Shoal Area.

The following technical changes (including justification) are requested by:

<u>Bryan Cherry</u>	<u>Site Supervisor</u>
(Name)	(Title)

Section 4.1 of the Fluid Management Plan (FMP) specifies that monitoring for tritium shall be conducted every four (4) hours during the aquifer development and testing phase. Well HC-5 has required more time to develop than predicted. Based on current pumping rates, it is estimated that an additional 28 days will be required before the well is fully developed. Tritium monitoring results to date do not demonstrate an upward trend in tritium activity or give any indication that tritium levels will exceed FMP action levels. This technical change will nullify the requirement to collect and analyze tritium monitoring samples for the remainder of the aquifer testing at the HC-5 well. Therefore, the only action required at HC-5 will be collection and analysis of a representative sump sample in accordance with Section 4.2 of the FMP, prior to discharge to the infiltration basin.

Section 4.1 of the FMP also specifies a weekly tritium monitoring frequency for wells involved in the tracer experiment. Based on a revised wellhead capture zone analysis and initial pumping test results, it is predicted that wells involved in the tracer test will not yield groundwater in excess of FMP parameters. This technical change will nullify the requirement to collect and analyze weekly tritium monitoring samples for the remainder of the tracer test. As with well HC-5, the only action required at the wells involved in the tracer test will be collection and analysis of a representative sump sample in accordance with Section 4.2 of the FMP, prior to discharge to the infiltration basin.

The project time will be (**Increased**)(~~Decreased~~)(~~Unchanged~~) by approximately 28 days

Applicable Project-Specific Document(s):

Fluid Management Plan for the Project Shoal Area, Off-Sites Project (DOE/NV-542, Rev. 0, April 1999)

CC:

Approved By:

Monica Sanchez Date 12/1/99
(Off-Sites Project Manager)

Russell Hyatt Date 12/1/99
(Division Director, Environmental Restoration Division)

Client Notified Yes X No Date Nov. 23, 1999

Contract Change Order Required Yes No X

Contract Change Order No.

UNCONTROLLED

Project Shoal Wellhead Capture Zone Analysis

by
Greg Pohll
Desert Research Institute
November 18, 1999

Introduction

An analysis of the potential fluid pathways induced by the current groundwater pumping at the Project Shoal Area (PSA) was performed to determine the risk of radionuclide transport from the PSA test to downgradient pumping wells. The semi-analytic model RESSQC (Blandford and Huyakorn, 1991) was used to determine the time-dependent capture zone for the proposed tracer test and purging of HC-5. The input parameters required by RESSQC are not known with full certainty, so the analysis was performed within a Monte Carlo framework to assess the uncertainty in the predicted capture zones.

Pumping is continuing at the PSA in wells HC-7 and HC-5. HC-7 is being used as the discharge well during the forced gradient tracer test and HC-5 is being pumped to remove remaining drilling fluids. HC-6 is currently being used as the injection well in which tracers are injected for short periods, followed by continuous injection of HC-7 discharge fluid. It is expected the tracer test will continue through the end of February, 2000 and the pumping at HC-5 will continue through the end of December, 1999.

Methodology

The semi-analytic model RESSQC (Blandford and Huyakorn, 1991) was used to determine the time dependent capture zones for HC-5 and HC-7. RESSQC is a two-dimensional model and as such assumes that all injection and pumping will be from similar depths. The well screen in HC-5 is approximately 700 m deeper than both HC-6 and HC-7, so the capture zones calculated will be extremely conservative as true migration paths are would require greater migration distances.

RESSQC also assumes that the aquifer is homogeneous, isotropic, and of constant saturated thickness. The fractured granite aquifer at the PSA is not homogeneous at the regional scale, but it is assumed that at the scale of the tracer test, the flow system can be represented by an equivalent homogeneous and isotropic porous media. The assumption that the pumping induced stress will not induce vertical flow (*i.e.* only two-dimension flow is simulated) is conservative as vertical flow would only serve to reduce the capture zone radius.

Table 1 below shows the injection and discharge rates used in the analysis.

Table 1 Injection and discharge rates used in the capture zone analysis.

Well	Injection Rate (GPM)	Discharge Rate (GPM)
HC-5	—	4
HC-6	0.3	—
HC-7	—	3

The groundwater flow and transport model of the PSA was used to assess the present distribution of radionuclides (Pohll, et al., 1998). This analysis suggests that the current radionuclide plume is restricted to a radius of less than 100 m from the test.

The aquifer parameters (transmissivity, effective porosity, and hydraulic gradient) were assumed to be uncertain parameters. Additional data has been collected near the test wells to refine the parameter distributions. Specifically, the aquifer test in HC-7 indicates transmissivity values near 1 m²/day and specific yields near 0.01. Specific yield is an aquifer property which is analogous to the effective porosity. The lack of breakthrough during the first two weeks of the tracer test also supports effective porosity values near 0.01. Table 2 shows the uncertain parameters and the associated distributions used in the analysis.

The RESSQC model was used to simulate the injection and pumping stresses during combined pumping of HC-5 and HC-7 for a 120-day period. RESSQC computes the time-dependent capture zone for the pumping wells by tracing the movement of fluid particles through the groundwater flow system. The fluid particles are traced in reverse direction until termination of the pumping. The program tracks multiple fluid particles to delineate the entire capture zone for the time-period of interest.

Table 2 Parameters and associated distributions used in capture zone analysis.

Parameter	Mean	Standard Deviation	Lower Bound	Upper Bound	Distribution
Transmissivity (m ² /day)	1	3	—	—	Log Normal
Effective Porosity	0.01	—	0.005	0.02	Log Uniform
Hydraulic Gradient	0.06	—	0.03	0.1	Uniform

Results and Discussion

Figure 1 shows the 99% confidence level for the simulated capture zone. The 99% confidence level is indicative of the worst case scenario in terms of potential migration of test related solutes toward the pumping wells.

Of the 100 realizations, none showed capture zones that intersected the calculated location of the radionuclide plume associated with the PSA test.

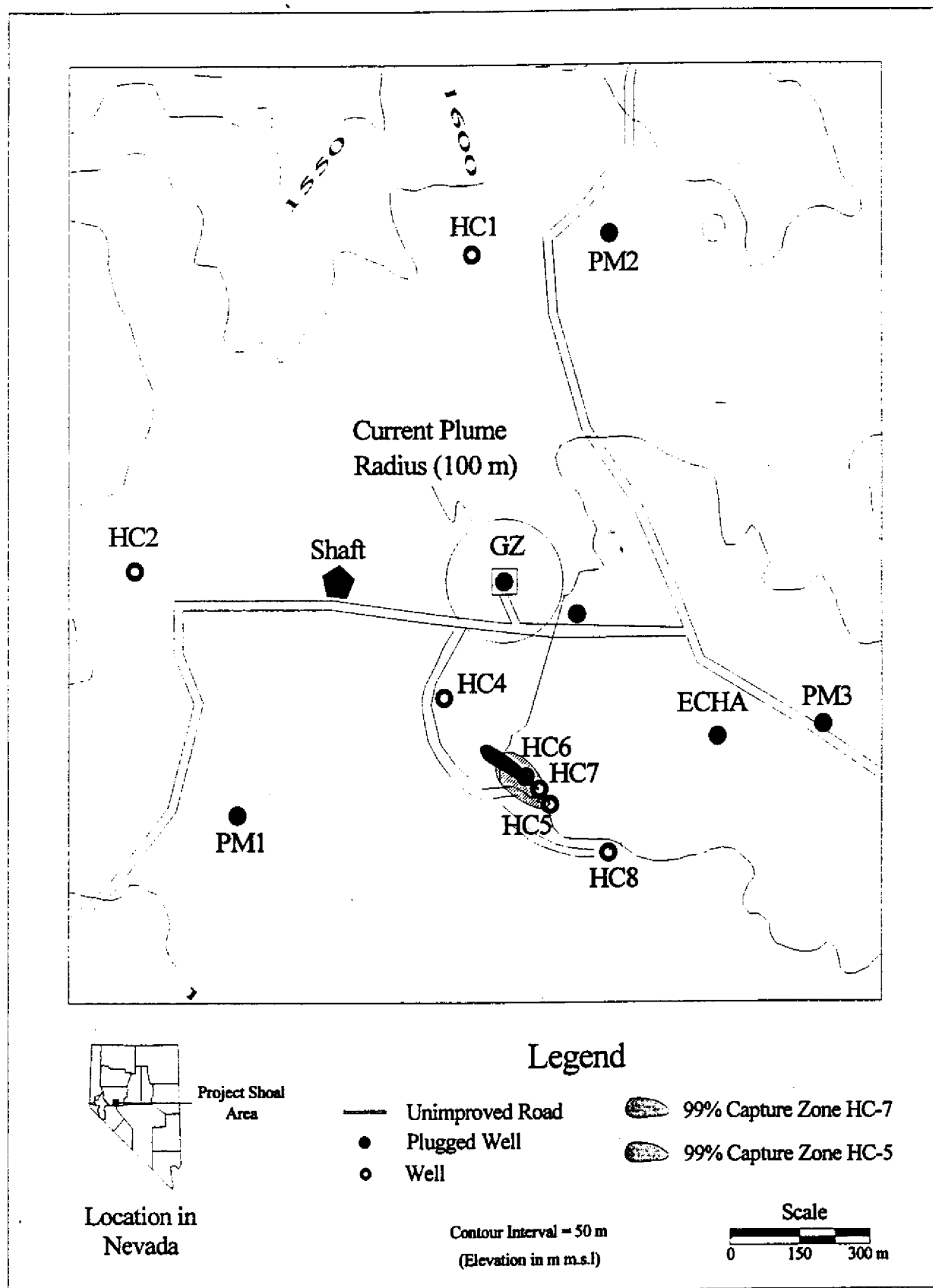


Figure 1 Predicted 99% capture zone confidence levels for HC-5 and HC-7.

Conclusions

A semi-analytical model, RESSQC, was used to determine the risk of encountering radionuclides in HC-5 and HC-7 associated with the 120 day tracer test and purging of drilling fluids.. The results indicate that there is a very low probability that either well will encounter test related solutes during the testing period.

References

- Blandford, T. N., and P. S. Huyakorn, 1991. WHPA 2.0 Code - A Modular Semi-Analytical Model for the Delineation of Wellhead Protection Areas. U.S. EPA Office of Ground-Water Protection, Washington, DC.
- Pohll, G., J. Chapman, A. Hassan, C. Papelis, R. Andricevic, and C. Shirley, 1998. Evaluation of Groundwater Flow and Transport at the Shoal Underground Nuclear Test: An Interim Report. Desert Research Institute, Water Resources Center Publication 45162.

Project Shoal Area HC-5 Tritium Activity

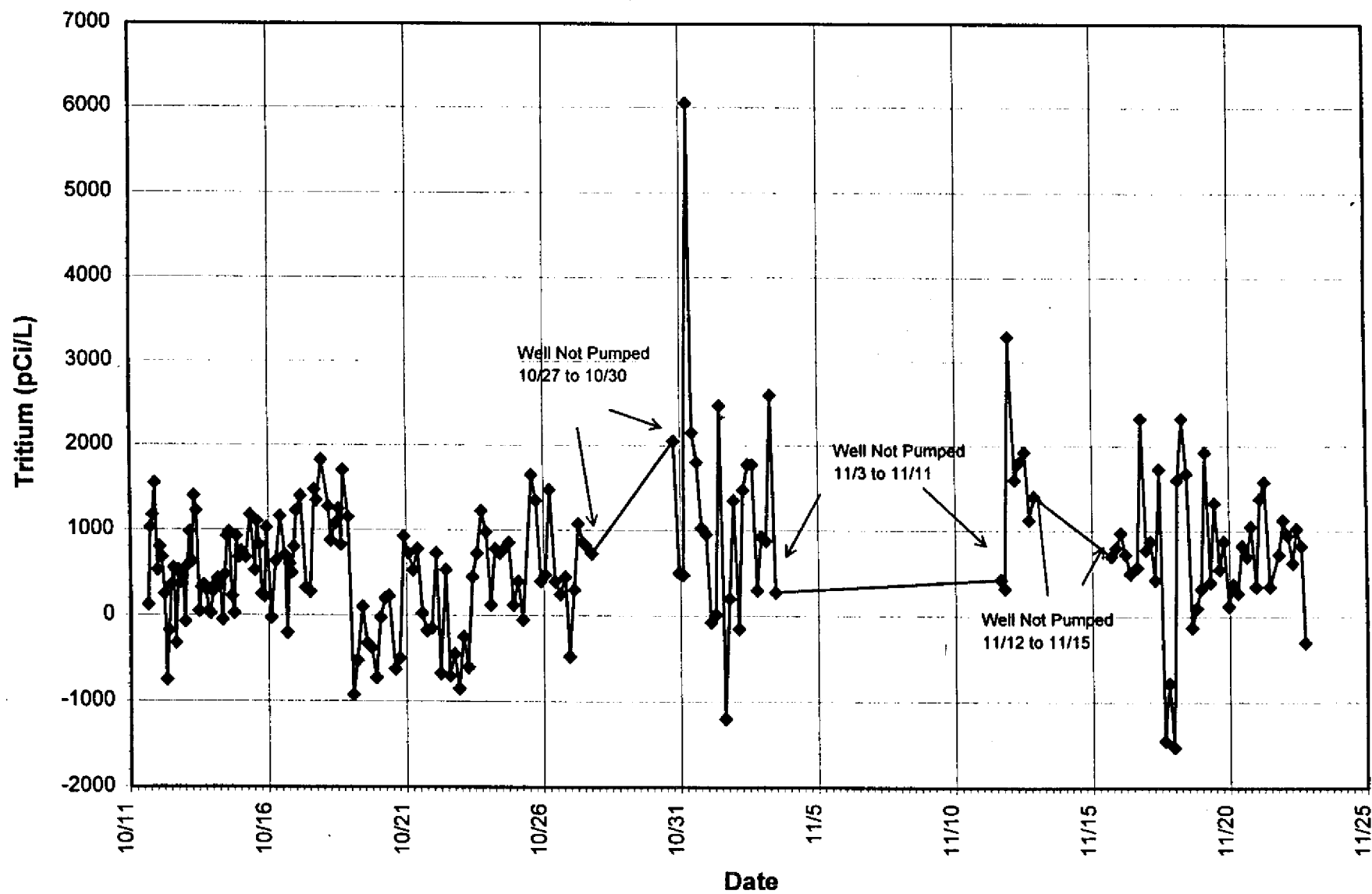


Table 3
HC-5 Tritium Monitoring Data

Date (mm/dd/yy)	Tritium (pCi/L)
10/11/1999 15:15	125
10/11/1999 17:25	1025
10/11/1999 19:25	1175
10/11/1999 21:30	1550
10/11/1999 23:30	525
10/12/1999 1:30	800
10/12/1999 3:30	675
10/12/1999 5:30	250
10/12/1999 7:30	-750
10/12/1999 9:30	-175
10/12/1999 11:30	350
10/12/1999 13:30	550
10/12/1999 15:30	-325
10/12/1999 17:35	525
10/12/1999 19:30	375
10/12/1999 21:30	450
10/12/1999 23:30	-75
10/13/1999 1:30	575
10/13/1999 3:40	975
10/13/1999 5:40	625
10/13/1999 7:40	1400
10/13/1999 9:40	1225
10/13/1999 11:30	50
10/13/1999 13:30	325
10/13/1999 15:30	350
10/13/1999 17:30	300
10/13/1999 19:30	50
10/13/1999 21:30	25
10/13/1999 23:30	275
10/14/1999 1:30	350
10/14/1999 3:30	425
10/14/1999 5:30	350
10/14/1999 8:00	-50
10/14/1999 10:00	475
10/14/1999 12:00	925
10/14/1999 14:00	975
10/14/1999 16:00	225
10/14/1999 18:00	28
10/14/1999 20:00	925
10/14/1999 22:00	675
10/15/1999 0:15	750
10/15/1999 4:05	675
10/15/1999 8:15	1175
10/15/1999 11:55	525
10/15/1999 14:00	1100
10/15/1999 16:00	825
10/15/1999 18:00	250

Table 3
HC-5 Tritium Monitoring Data

Date (mm/dd/yy)	Tritium (pCi/L)
10/15/1999 20:00	225
10/15/1999 22:00	1025
10/16/1999 2:00	-27
10/16/1999 6:10	632
10/16/1999 10:05	1158
10/16/1999 14:00	700
10/16/1999 16:00	-200
10/16/1999 18:00	600
10/16/1999 20:00	500
10/16/1999 22:00	800
10/17/1999 0:00	1225
10/17/1999 4:05	1400
10/17/1999 8:10	325
10/17/1999 11:55	275
10/17/1999 16:00	1475
10/17/1999 18:05	1350
10/17/1999 22:15	1825
10/18/1999 4:04	1275
10/18/1999 6:13	875
10/18/1999 10:16	1075
10/18/1999 13:05	1250
10/18/1999 15:00	825
10/18/1999 17:00	1700
10/18/1999 21:15	1150
10/19/1999 1:24	-925
10/19/1999 5:03	-525
10/19/1999 9:19	100
10/19/1999 13:20	-325
10/19/1999 17:10	-375
10/19/1999 21:28	-725
10/20/1999 1:03	-25
10/20/1999 5:12	200
10/20/1999 8:34	225
10/20/1999 13:44	-625
10/20/1999 17:47	-500
10/20/1999 21:38	925
10/21/1999 1:34	725
10/21/1999 5:30	525
10/21/1999 9:30	775
10/21/1999 13:30	25
10/21/1999 17:31	-175
10/21/1999 21:38	-150
10/22/1999 1:51	725
10/22/1999 5:30	-675
10/22/1999 10:08	528
10/22/1999 13:22	-700
10/22/1999 17:40	-450

Table 3
HC-5 Tritium Monitoring Data

Date (mm/dd/yy)	Tritium (pCi/L)
10/22/1999 21:37	-850
10/23/1999 1:35	-250
10/23/1999 5:30	-600
10/23/1999 9:30	450
10/23/1999 13:37	725
10/23/1999 17:34	1225
10/23/1999 21:34	975
10/24/1999 1:50	125
10/24/1999 5:50	775
10/24/1999 9:38	725
10/24/1999 13:26	775
10/24/1999 17:42	850
10/24/1999 21:23	125
10/25/1999 1:35	400
10/25/1999 5:47	-50
10/25/1999 13:36	1650
10/25/1999 17:30	1350
10/25/1999 21:25	400
10/26/1999 1:24	475
10/26/1999 5:29	1475
10/26/1999 9:55	400
10/26/1999 14:35	250
10/26/1999 18:48	450
10/26/1999 22:31	-475
10/27/1999 2:25	300
10/27/1999 6:23	1075
10/27/1999 10:30	852
10/27/1999 12:30	825
10/27/1999 17:58	725
10/30/1999 18:20	2050
10/30/1999 22:20	500
10/31/1999 2:15	475
10/31/1999 6:20	6050
10/31/1999 10:20	2150
10/31/1999 14:15	1800
10/31/1999 18:25	1025
10/31/1999 22:25	950
11/1/1999 2:25	-75
11/1/1999 6:30	15
11/1/1999 10:35	2475
11/1/1999 14:25	-1200
11/1/1999 18:35	200
11/1/1999 22:25	1350
11/2/1999 2:25	-150
11/2/1999 6:35	1475
11/2/1999 10:35	1775
11/2/1999 14:30	1775

Table 3
HC-5 Tritium Monitoring Data

Date (mm/dd/yy)	Tritium (pCi/L)
11/2/1999 18:30	300
11/2/1999 22:25	925
11/3/1999 2:25	875
11/3/1999 6:35	2600
11/3/1999 10:35	275
11/11/1999 15:30	425
11/11/1999 18:57	325
11/11/1999 18:57	325
11/11/1999 22:55	3300
11/12/1999 4:00	1600
11/12/1999 8:04	1800
11/12/1999 12:55	1925
11/12/1999 16:54	1125
11/12/1999 21:02	1400
11/15/1999 16:41	700
11/15/1999 20:53	800
11/16/1999 1:00	975
11/16/1999 5:00	725
11/16/1999 9:00	500
11/16/1999 15:15	575
11/16/1999 19:05	2325
11/16/1999 23:00	775
11/17/1999 3:00	875
11/17/1999 7:00	425
11/17/1999 11:00	1725
11/17/1999 15:00	-1450
11/17/1999 19:00	-775
11/17/1999 23:00	-1525
11/18/1999 3:00	1600
11/18/1999 7:00	2325
11/18/1999 11:00	1675
11/18/1999 15:00	-125
11/18/1999 19:00	100
11/18/1999 23:00	325
11/19/1999 3:00	1925
11/19/1999 7:00	400
11/19/1999 11:00	1325
11/19/1999 15:00	550
11/19/1999 19:00	875
11/19/1999 23:00	125
11/20/1999 3:00	375
11/20/1999 7:00	275
11/20/1999 11:00	825
11/20/1999 15:00	700
11/20/1999 19:00	1050
11/20/1999 23:00	350
11/21/1999 2:58	1375

Table 3
HC-5 Tritium Monitoring Data

Date (mm/dd/yy)	Tritium (pCi/L)
11/21/1999 6:50	1575
11/21/1999 10:58	350
11/21/1999 19:05	725
11/21/1999 23:05	1125
11/22/1999 2:57	950
11/22/1999 7:01	625
11/22/1999 10:55	1025
11/22/1999 14:52	825
11/22/1999 17:30	-300